Boğaziçi University
Department of Physics

Phys 443 Fall 2011

Problem Set 1

Due on October 19th, 2011

Problem 1 – *10 pts*

Consider the following integral:

$$I = \int_{-1}^{2} 2\exp\left(-\frac{(x-0.5)^2}{3}\right) dx$$

a) Write a Monte Carlo code that evaluates I and σ_I for $N = 10^m$ where $m = 1, \cdots, 6$ with $w(x) = 1$.

b) Find a proper weight function which improves your error as much as possible, and reevaluate the integral with that weight function.

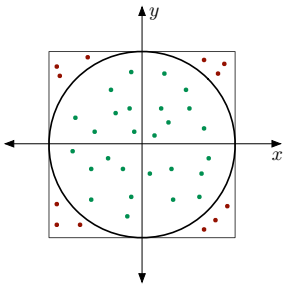
Give your answer as follows:

N	I_1	σ_{I_1}	I_2	σ_{I_2}
10	...	...	...	...
100				

where I_1 is calculated with $w(x) = 1$, and I_2 is calculated with $w(x) = \cdots$.

Problem 2 – *0 pt*

Find the number π using Monte Carlo method as the area of a circle placed within a 2×2 square. Find the error in A_{MC} for $N = 10^6$.



$$A_{MC} = \frac{1}{N}\sum_{i}^{N} A_i \qquad \text{where } A_i = \begin{cases} 2\times 2 & \text{If } r \le 1 \\ 0 & \text{otherwise} \end{cases}$$

Problem 3 – *10 pts*

Consider a cylinder:

$$x^2 + y^2 = 1$$

and, a square bar, with cross section on the xz plane with $-1.5 < x < 0.5$ and $-0.5 < z < 1.5$. Calculate the volume of the intersections of these two objects using Monte Carlo integration with a precision of $10^{-4}V$, where V is the volume in question.